Energy Economics 40 (2013) 297–305

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneco

Resource adequacy reliability and the impacts of capacity subsidies in competitive electricity markets☆

R.J. Briggs, Andrew Kleit *

Department of Energy and Mineral Engineering, The Pennsylvania State University, United States

ARTICLE INFO

Article history:
Received 17 January 2013
Received in revised form 5 July 2013
Accepted 10 July 2013
Available online 3 August 2013

JEL classification:
L51
Q48
H77
H44
L13
L94

Keywords:
Electricity markets
Competitive
Resource adequacy
Reliability
Capacity market
Transmission constraints
Minimum offer price rule
PJM

ABSTRACT

Motivated by recent interventions by the states of New Jersey and Maryland and the introduction of PJM's Minimum Offer Price Rule (MOPR) for capacity markets, we analyze the impact of subsidized government investments in electrical generation on electricity markets. We extend the model of Joskow and Tirole (2007) to address the interconnected nature of the PJM grid by considering a market with two different locations connected by transmission lines. We assume that these lines are constrained during peak periods in a manner similar to Borenstein et al. (2000). We find that government intervention has a significant potential for adverse effects on grid resource adequacy and reliability. In our analysis, subsidized investment in baseload capacity is never optimal. In the short run government provision of base capacity displaces competitive base capacity, which reduces the private provision of peak capacity. In the long run, the threat of intervention imposes costs on suppliers in the form of an expected regulatory taking. As a result, resource adequacy decreases in both markets. If governments respond to this state of affairs by subsidizing further supply additions, expectations of intervention are reinforced and competitive capacity supply further diminishes. MOPR attempts to mitigate this vicious cycle by screening out non-economic bids for new capacity. To the extent market participants view MOPR as a credible policy, it succeeds in this goal. In this case, subsidized capacity additions do not perturb the efficiency of market outcomes as long as any charges to consumers to support the subsidy are lump sum in nature. In this case, subsidized resources simply succeed in capturing rents from taxpayers.

> "…*the thought that the lights might go out in Maryland as a result of our actions, or inactions, during our term as Commissioners is one that keeps us awake.*"
>
> [—Maryland Public Service Commission (2012)]

1. Introduction

Restructured electricity markets have arisen around the world and in numerous states in the US. Restructuring is based upon the conclusion that the generation of electricity is not a natural monopoly and therefore can be opened to market forces. It is also based upon the assumption that political forces will not actively seek to alter market results.

The assumption of limited political intervention is currently being tested by the state governments of New Jersey and Maryland in the eastern United States. The governments of these states argue that the wholesale electricity markets in their areas are not operating optimally and are therefore pursuing subsidized investments in base-load generation capacity. New Jersey implemented its Long-term Capacity Agreement Pilot Program (LCAPP) in 2011 to develop 2000 mega-watts (MW) of new electric generation facilities in the state. Maryland similarly ordered construction of from 650 to 700 MW of baseload generation capacity in 2012. These states assert that these resources will improve resource adequacy and provide better outcomes for consumers in the form of lower prices.

The actions of New Jersey and Maryland likely have ramifications beyond their borders. New Jersey imported 13.5 terawatt-hours (TWh) out of 79.2 TWh consumed in 2010, while Maryland imported 21.7 TWh out of 65.3 TWh consumed in the same period (US EIA, 2012). The imported electricity is delivered from other states via transmission lines that are often congested. Understanding the implications of the New Jersey and Maryland interventions requires accounting for this linkage, as well as other unique elements of electricity markets.

☆ Disclosure: This research is supported by the Penn State's Electricity Markets Initiative (EMI). Sponsors of EMI are interested parties: Direct Energy, Exelon Corporation, FirstEnergy Solutions, GenOn Energy, and PPL EnergyPlus.

* Corresponding author at: 213 Hosler Building, University Park, PA 16802-5000, United States. Tel.: +1 814 865 0711.
E-mail address: ank1@psu.edu (A. Kleit).

0140-9883/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.eneco.2013.07.009

To analyze the impact of subsidized government investment in electrical generation on electricity markets in the short and long runs, we extend the model of Joskow and Tirole (2007) ("J&T") to address the interconnected nature of the PJM grid by considering a market with two different locations—an "upstream" exporter and "downstream" importer—connected by transmission lines. We assume that these lines are constrained during peak periods as in Borenstein et al. (2000). We characterize the Ramsey equilibrium of this model and discuss the role of capacity markets in supporting this optimum. We then analyze the effects of government capacity investments. This analysis informs our discussion of the current electricity market policy actions of New Jersey and Maryland and mitigation actions taken by PJM.

We find that subsidized base capacity investments have significant potential for adverse effects on electricity markets. Subsidized investment in baseload capacity is never optimal in our model. In the short run these policies depress prices, with some benefits for both downstream and upstream consumers, but they do so at the expense of misallocating resources and reducing incentives for peak capacity investment in the long run. Intervention creates expectations of regulatory costs, leading suppliers to invest relatively less at every capacity price. If governments respond to this state of affairs by intervening again, a vicious cycle can arise and government's perceived need to intervene may become self-fulfilling. PJM's regulatory response to subsidized capacity investments—the Minimum Offer Price Rule (MOPR) in its capacity markets—attempts to avoid this cycle by screening "non-economic" bids out of the capacity market.

Section 2 provides background on capacity markets and the debate over direct government interventions. In Section 3 we describe the model of J&T and extend it to allow for transmission constraints. Given this model, we then derive the necessary conditions for efficient outcomes in a competitive market (the Ramsey equilibrium). We analyze the role of capacity markets as an instrument to induce the Ramsey equilibrium and investigate the effects of government generation investments in Section 4. We conclude with a summary of our main results.

2. Background: capacity markets and state capacity investment policies

This section begins with a brief introduction to electricity markets, some of their inherent economic problems, and the role of capacity markets in addressing these problems. We then turn to the political debate over capacity markets and describe the recent interventions.

2.1. What is a capacity market?

Capacity markets exist to address market failures associated with electricity grid resource adequacy. Prior research argues that competitive electricity markets underinvest in resource adequacy for several reasons (cf. Cramton and Stoft, 2005; Lesser and Israelevich, 2005; J&T; Cramton and Ockenfels, 2011). We note two fundamental issues here. First, without sufficient demand response, demand for electricity is highly inelastic, and real-time price signals to end-use consumers are largely absent. If demand exceeds available supply, system operators must curtail the demand of some users to maintain energy balance or risk a widespread blackout that imposes large costs on both sides of the market. This feature of electricity markets implies that resource adequacy is a non-excludable good. Private suppliers therefore have insufficient incentives to supply resource adequacy, and end-use customers have incentives to free-ride and under-procure the socially optimal quantity of resource adequacy.

At the same time, the presence of price caps in the wholesale energy market further reduces incentives for resource adequacy. Price caps exist to curtail the exercise of market power during peak demand events. Because price caps are arguably set lower than the marginal social value of energy during peak periods, they offer insufficient incentives for precisely the generators that would provide the necessary additional capacity above baseload to meet peak demand. This well-known issue is often termed the "missing money problem" (cf. Hogan, 2005; Shanker, 2003; J&T).

At least two basic types of policies can address the resource adequacy problem. First, regulators can raise the price cap on wholesale generation prices to the social value of generation at the peak—the "Energy Only" solution.[1] A higher price cap, however, expands the scope for the market power of peak suppliers because of the inelasticity of demand (Stoft, 2003). Second, regulators can require load-serving entities (LSEs), whether local electric utilities or competitive electricity providers, to contract into the future for access to specified amounts of generating capacity such that each LSE will be individually reliable and the system will be reliable as a whole.[2] These contracts may be negotiated bilaterally or their price may be determined in a centralized auction—a "capacity market".[3]

In a capacity market, generators bid to supply forward availability of their capacity in a particular regional transmission organization (RTO). These markets exist in several major US RTOs, including PJM, ISO-NE, and to some extent the Midwest ISO. Ausubel and Cramton (2004) set out and analyze a basic auction structure for these markets, and Cramton and Stoft (2005) discuss the design of the ISO-NE capacity market and contrast it with the PJM design.

2.2. The LCAPP debate and intervention

Despite the underlying economic logic, capacity markets are controversial because some see them as windfalls for generators (e.g. American Public Power Association, 2011; Energy Choice Matters, 2011; PennFuture, 2012). Opponents of these policies argue that capacity markets create higher electricity prices without incentivizing the construction of new generation. While the reserve margin in PJM is approximately 20% through 2012 (PJM, 2011) and is forecast to remain near that level to 2015, the lack of new built generation is nonetheless viewed by some as indicative of a threat to resource adequacy.[4] To address this purported resource adequacy issue, New Jersey will build 2000 MW of new electric generation facilities within the state over the next three years under its LCAPP Program, while Maryland has elected to add 650 to 700 MW.[5]

Taxpayers in these states will financially support these investments. In New Jersey particularly, ratepayers will pay fixed, non-bypassable charges to cover the subsidy costs of LCAPP. The use of subsidies implies that either the investments would not be sufficiently profitable ("non-economic") in their absence or that the contracting firms succeeded in capturing rents. In either case, taxpayers rather than market participants bear the risk for investment performance, which runs counter to one of the main purposes of electricity market restructuring.

These subsidized resources planned to bid into the PJM capacity auction at the lowest possible value (e.g. Hogan, 2011). Because of concerns that this strategy would damage the functioning of PJM's capacity market, the Federal Energy Regulatory Commission in 2011 approved changes to PJM's Minimum Offer Price Rule (MOPR).[6] For new resources,

[1] Arguably, this approach has been adopted in large part by the ERCOT market in Texas: wholesale price caps are proposed to reach as high as $9000 per MWh vs. $1000 per MWh in PJM and elsewhere (Public Utility Commission of Texas, 2012). See Newell et al. (2012) for a discussion of resource adequacy issues and policy options in ERCOT.

[2] Chandley (2008) provides details on the precise implementation of the PJM capacity market, known as the Reliability Pricing Model (RPM).

[3] See Cramton and Stoft (2007) for a comparison of bilateral capacity contracts and capacity markets.

[4] The reserve margin is the amount by which the system's total electric power capacity exceeds maximum electricity demand.

[5] For reference, installed capacity levels in Maryland and New Jersey are approximately 22,000 MW and 13,000 MW, respectively (Advanced Energy Economy, 2011).

[6] See PJM Interconnection LLC, 117 FERC 61,331 at P 103 (2006) for the establishment of MOPR. For information on recent changes and the current state of MOPR, see PJM Interconnection LLC, 143 FERC 61,090 (2013).